CLAIMS

1. An image processing apparatus for processing input image data and for outputting output image data, the image processing apparatus comprising:

an edge detection unit for detecting an edge gradient direction with the largest gradient of pixel values and an edge direction orthogonal to the edge gradient direction for each pixel of the input image data;

an edge direction processing unit for performing smoothing processing on the image data in the edge direction for each pixel of the output image data in accordance with a detection result of the edge detection unit and for sequentially outputting pixel values corresponding to respective pixels of the output image data; and

an edge gradient direction processing unit for performing edge enhancement processing in the edge gradient direction on the pixel values output from the edge direction processing unit for the respective pixels of the output image data in accordance with the detection result of the edge detection unit and for sequentially outputting pixel values of the output image data.

2. The image processing apparatus according to Claim 1, wherein after generating interpolated image data in the edge

direction based on interpolation processing for the input image data on a line extending in the edge direction for the respective pixels of the output image data in accordance with the detection result of the edge detection unit, the edge direction processing unit sequentially outputs the pixel values corresponding to the respective pixels of the output image data by performing filtering processing on the interpolated image data in the edge direction.

3. The image processing apparatus according to Claim 2, wherein the edge direction processing unit changes the number of taps for the filtering processing in accordance with a reliability of an edge in the edge direction.

4. The image processing apparatus according to Claim 3, wherein the changing of the number of taps for the filtering processing performed by the edge direction processing unit is changing of the number of taps in a decimal fractional part by changing a weighting coefficient in accordance with the reliability of the edge in the edge direction and by performing weighting addition of filtering processing results of different numbers of taps using the weighting coefficient.

5. The image processing apparatus according to Claim 3,

wherein the reliability of the edge in the edge direction is a ratio of a dispersion of the gradient of the pixel values in the edge direction to a dispersion of the gradient of the pixel values in the edge gradient direction.

6. The image processing apparatus according to Claim 1, wherein after generating interpolated image data in the edge gradient direction based on interpolation processing for the image data based on the respective pixel values output from the edge direction processing unit on a line extending in the edge gradient direction for the respective pixels of the output image data in accordance with the detection result of the edge detection unit, the edge gradient direction processing unit sequentially outputs the pixel values of the output image data by performing filtering processing on the interpolated image data in the edge gradient direction.

7. The image processing apparatus according to Claim 1,

wherein the output image data is image data obtained by changing a sampling pitch of the input image data, and

wherein the image processing apparatus further includes:

an interpolation processing unit for performing an interpolation operation on the input image data and for outputting interpolated image data with a sampling pitch of

the output image data;

a blend ratio determination unit for changing a weighting coefficient for blending in accordance with a reliability of an edge in the edge direction; and

a blend processing unit for performing weighting addition of the image data output from the edge gradient direction processing unit and the interpolated image data using the weighting coefficient for blending and for outputting the output image data.

8. The image processing apparatus according to Claim 1, further comprising:

a blend ratio determination unit for changing a weighting coefficient for blending in accordance with a reliability of an edge in the edge direction; and

a blend processing unit for performing weighting addition of the image data output from the edge gradient direction processing unit and the input image data using the weighting coefficient for blending and for outputting the output image data.

9. An image processing method for processing input image data and for outputting output image data, the image processing method comprising:

an edge detection step of detecting an edge gradient

direction with the largest gradient of pixel values and an edge direction orthogonal to the edge gradient direction for each pixel of the input image data;

an edge direction processing step of performing smoothing processing on the image data in the edge direction for each pixel of the output image data in accordance with a detection result by the edge detection step and sequentially detecting pixel values corresponding to respective pixels of the output image data; and

an edge gradient direction processing step of performing edge enhancement processing in the edge gradient direction on the pixel values detected by the edge direction processing step for the respective pixels of the output image data in accordance with the detection result by the edge detection step and sequentially outputting pixel values of the output image data.

10. A program for an image processing method performed by arithmetic processing means for processing input image data and for outputting output image data, the program comprising:

an edge detection step of detecting an edge gradient direction with the largest gradient of pixel values and an edge direction orthogonal to the edge gradient direction for each pixel of the input image data;

an edge direction processing step of performing smoothing processing on the image data in the edge direction for each pixel of the output image data in accordance with a detection result by the edge detection step and sequentially detecting pixel values corresponding to respective pixels of the output image data; and

an edge gradient direction processing step of performing edge enhancement processing in the edge gradient direction on the pixel values detected by the edge direction processing step for the respective pixels of the output image data in accordance with the detection result by the edge detection step and sequentially outputting pixel values of the output image data.

11. A recording medium recording thereon a program for an image processing method performed by arithmetic processing means for processing input image data and for outputting output image data, the program for the image processing method comprising:

an edge detection step of detecting an edge gradient direction with the largest gradient of pixel values and an edge direction orthogonal to the edge gradient direction for each pixel of the input image data;

an edge direction processing step of performing smoothing processing on the image data in the edge direction

for each pixel of the output image data in accordance with a detection result by the edge detection step and sequentially outputting pixel values corresponding to respective pixels of the output image data; and

an edge gradient direction processing step of performing edge enhancement processing in the edge gradient direction on the pixel values detected by the edge direction processing step for the respective pixels of the output image data in accordance with the detection result by the edge detection step and sequentially outputting pixel values of the output image data.